Fermilab/AD/TEV
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Tevatron Beam Position Monitor (BPM) Upgrade

Filter Card Test Report

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Introduction

This document contains the results of the testing of the Filter Card (FC) in satisfaction of the requirements needed to release the design to production. The FC provides the following signal conditioning and diagnostics functions:

1. Signal attenuation of 20 dB for proton and 10 dB for anti proton signals.
2. Band pass filtering.
3. Diagnostic signal injecting.

Test Plan

Analog Sections:

1. Measure the return loss (S11) in a 10 MHz frequency range around a 53.104 center frequency with the relays in their default states.
    a. Plot the return loss for a representative channel of the module.
    b. Repeat the measurement for all eight channels looking for differences between channels. Differences between channels should be similar to the measurement-to-measurement variation of one channel.
2. Measure the insertion loss (S21) in a 10 MHz frequency range around a 53.104 center frequency with the relays in their default states.
    a. Plot the insertion loss for a representative channel of the module.
    b. Repeat the measurement for all eight channels looking for differences between channels. Differences between channels should be similar to the measurement-to-measurement variation of one channel.
3. Measure cross talk by repeating 2 above after modifying the test set-up. Inject the signal into one channel and monitor the output of the neighbor channel(s).

    a. Plot the cross talk as insertion loss for the neighbor channels of a representative channel.
    b. Repeat the measurement for all eight channels looking for differences between channels. Differences between channels should be similar to the measurement-to-measurement variation of one channel.
4. Measure channel pair matching by repeating 2 above compare channel 1 & 2, 3 & 4, 5 & 6, and 7 & 8. The difference between channels should be small.
    a. Plot the insertion loss for a representative channel pair.
    b. Repeat the measurement for all four pairs looking for large differences between channels. Large differences should be understood and repaired if possible.
5. Measure the distortion of the channels by inserting a clean 53.104 MHz signal into the normal input and recording the distortion on the output. Record as distortion percent or as narrow-band spectral plots of the input and output.
6. Measure the spectrum of the diagnostic signal from the timing card at the input and output of the module. Look at the channel inputs with the diagnostic signal sent to the input only and to both the input and output. Look at the output port with the diagnostic signal to output only and to both the input and output.

Digital Section:

Initialize the FC from the timing module. Exercise all relays on one module confirming relay activation with an ohmmeter. Misaddress the module and confirm that the relays do not activate.

Test results

The detailed results are contained in the spreadsheets in the file ProtoTests.xls. This is in the AD document database as Document #1384. Representative results and summaries are provided here. The result index numbers are the same as the test plan index numbers.

1. Return loss measurements are less than –34 dB on all channels in a 10 Mhz band centered at 53.104 Mhz. See typical plot in Figure 1 below.

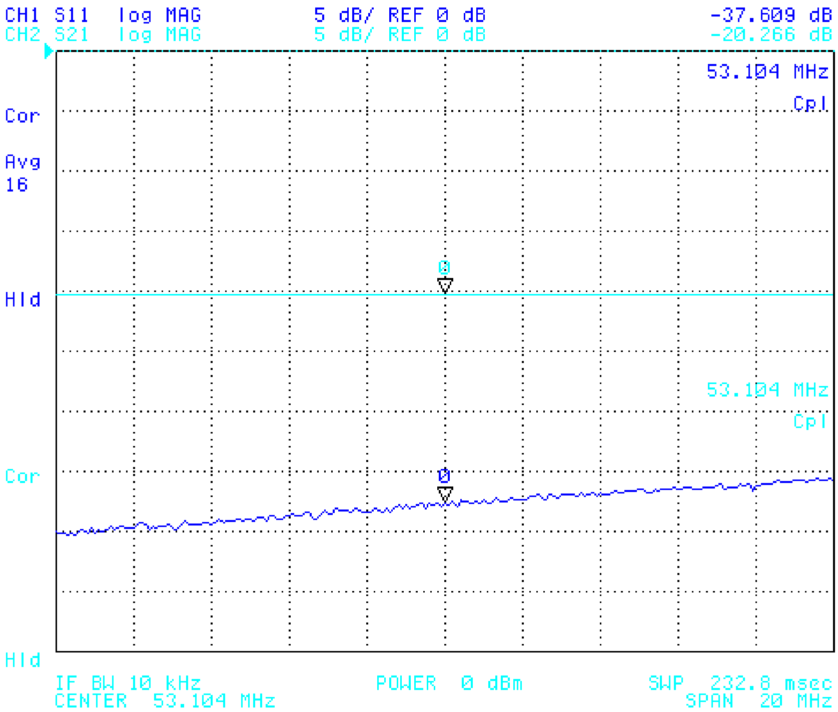

Figure 1 Reflected Energy and Transfer Loss

2. Transfer loss measurements are between 10.27 – 10.28 dB for 10 dB channels and 20.33 – 20.36 on 20 dB channels at 53.104 Mhz. See typical plot in Figure 1 above.

3. Cross talk is less than 80 dB on all channels. See a typical plot in Figure 2 below.

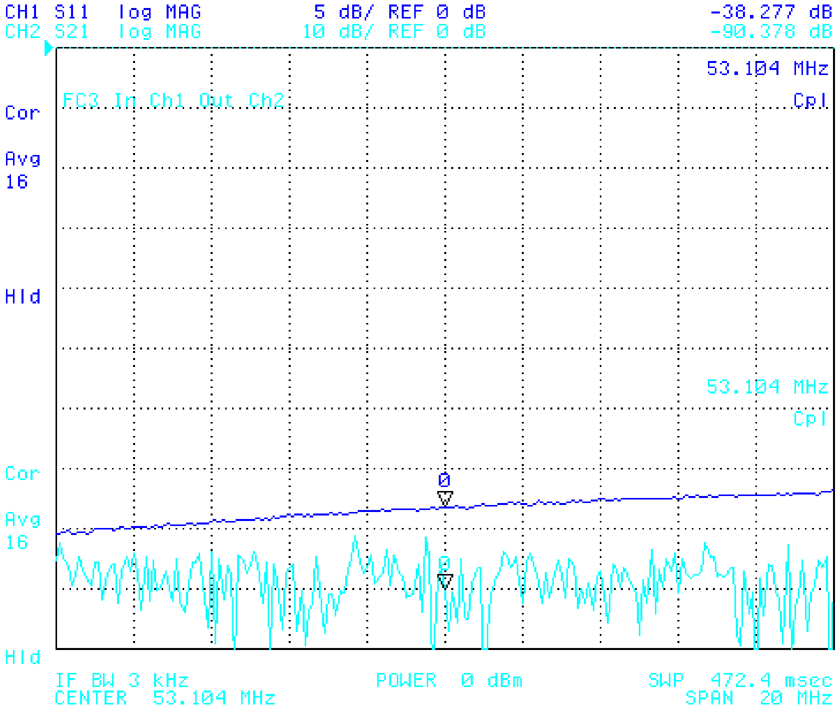

Figure 2 Cross Talk

4. Signal matching between channel pairs is less than 0.5 dB for return loss and less than 0.1 dB for transfer loss. See Figure 3 for a typical plot.

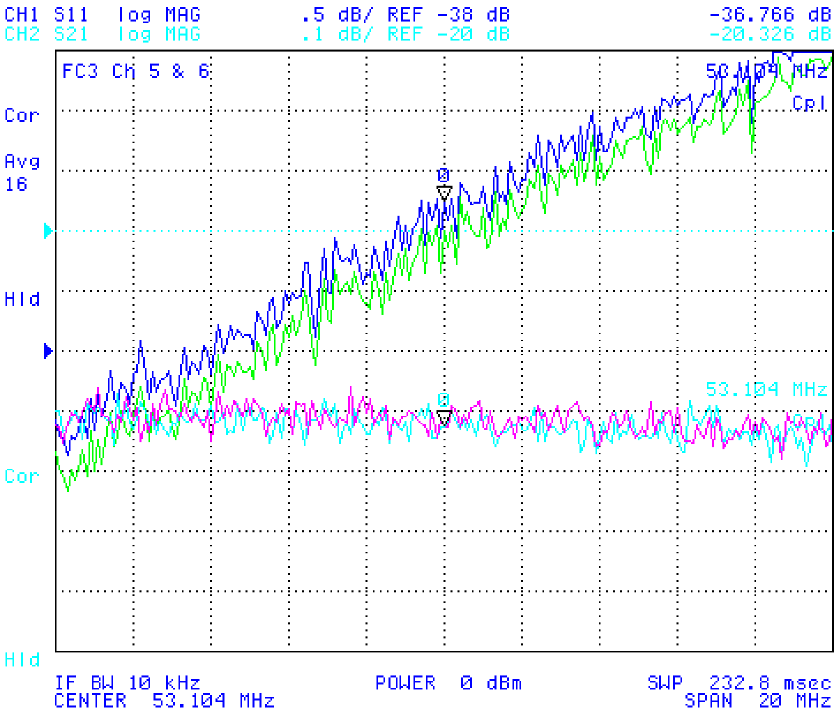

Figure 3 Channel Pair Differences

5. Spectrum plots showed good signal purity. See a typical plot in Figure 4.

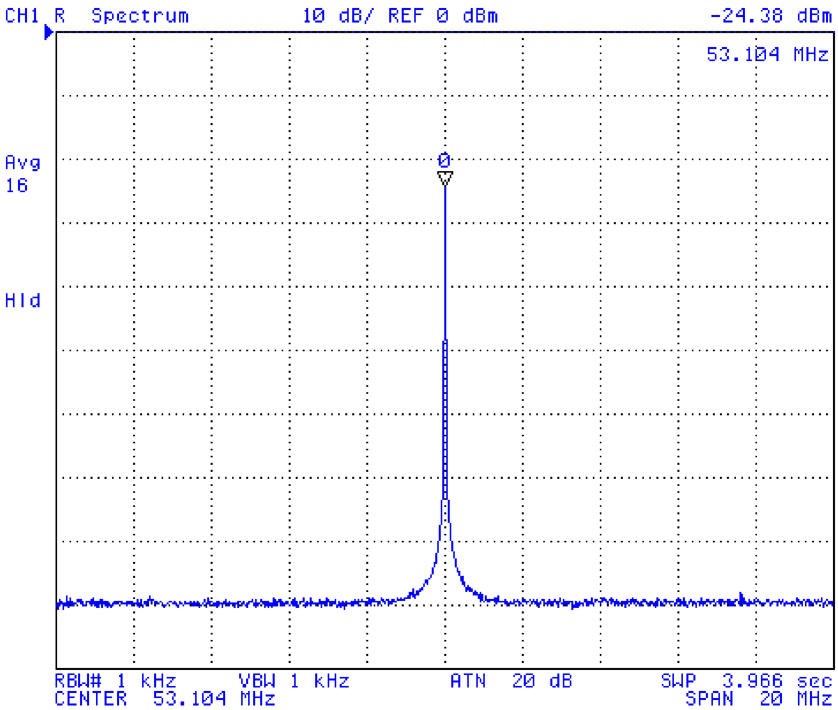

Figure 4 Spectral Energy

6. The diagnostic signal has injected using all possible relay settings under the control of the Timing Generator Fanout Module. Spectrum plots showed all side bands within +/- 10 Mhz of 53.104 to be less than – 40 dB of the test signal. See Figure 5 for a typical plot.

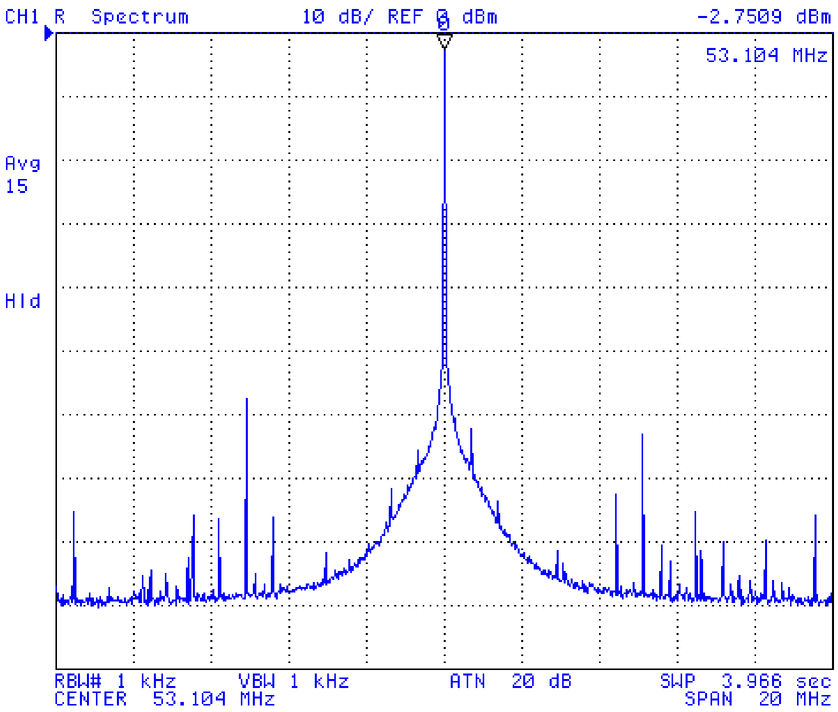

Figure 5 Diagnostic Signal Spectrum

Conclusion

The connectivity requirements for inputs, outputs and within the board have been demonstrated. The test plan shows the boards will satisfy the system requirements. All relay operations and communication where tested using the Timing Generator Fanout module. See Beams-doc-1384 for the complete test data for FC SN P3.

Five pilot boards have been assembled and 3 have been through detailed testing as of 30 September 2004.

Change Log

Version	Issue Date	Description of Change
1.0	30 Sept 2004	Original KRT

Concurrence

Following persons reviewed and concurred with the content of this document.

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Steve Wolbers, Project Manager (date)

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Bob Webber, Deputy Project Manager (date)

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Jim Steimel, Technical Coordinator (date)

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Vince Pavlicek, Subsystem manager (date)

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Margaret Votava, Subsystem manager (date)